

REMARKS/ARGUMENTS

Status of the Claims

The Examiner has noted that claims 14-24 have been withdrawn from further consideration, as being drawn to a non-elected invention, and applicant confirms the election of claims 1-13 for examination.

The remaining claims 1-13 stand rejected under 35 U.S.C. 103(a) as being obvious over Oliver et al. U.S. Patent 5,688,293 in view of Ashida et al. U.S. Patent 6,200,706.

Present Invention

Before addressing this rejection, the present invention is reviewed, since an important aspect of the argument below is that the Examiner has fundamentally misconstrued the present invention and the prior art.

The present invention has an inert, porous, pliable separator composed of at least three polymer sub-layers, which can be identified as follows:

- (1) An inert, first, porous laminate layer of a first polymer, that in turn comprises a multiplicity of porous sub-layers, including at least one sub-layer having one melting temperature;
- (2) A sub-layer of the first, porous laminate layer having a second different melting temperature;
- (3) An adherent, solid, second polymer layer containing a first lithium compound having dissociable lithium ions, deposited on at least one of the major faces of the inert, first, porous, laminate first layer of polymer.

It can be noted that these three layers are all solid, and form a separator that is porous. As defined in the claim, the second layer of a second polymer "partially fills one portion of said first multiplicity of pores of said inert, first, porous laminate layer". The claim then provides that a "first multiplicity of pores" is unfilled and is "impregnated with an organic liquid containing a second lithium compound having the dissociable lithium ions".

When construing this claim, it is to be noted that this reference to a filling of the first and second portions of the multiplicity of pores does not mean that the materials filling these first and second portions have similar characteristics. Some of the characteristics may be the same, but some are different. Thus, the "first portion" is filled with the second polymer, which is solid. The second portion of the pores is then impregnated with "an organic liquid". The claim does provide that both the second polymer and the organic liquid contain dissociable lithium ions so as to provide electrolyte capability, but again, for emphasis, it is to be noted that the second layer is a solid, while the organic liquid is, as indicated, a liquid, i.e. anything other than a solid.

As a consequence of the second layer being a solid, this means that, in effect, the electrolyte has a separator that has the three separate layers listed above, namely:

- (1) At least one porous sub-layer of a first melting temperature;
- (2) At least one second porous sub-layer of a second and different melting temperature;
- (3) The second polymer forming a second layer.

Further, with respect to claim 2, one can note that this further requires that the first laminate layer comprise "one porous sub-layer sandwiched between at least two

other sub-layers" with the sandwiched porous sub-layer having a "significantly lower melting temperature than the other sub-layers". The intent here is that, when the melting temperature of that middle layer is reached, while the two outer sub-layers will remain un-melted, this sandwiched or middle porous sub-layer will melt, so as to shut down the battery action. This is a safety effect, to prevent over heating of a battery.

Response to rejection under 35 U.S.C. 103

The Examiner cited Oliver '293 for teaching a composite electrolyte for a rechargeable lithium battery comprising:

"an inert first porous, laminate layer of first polymer (52) having a first multiplicity of pores include walls, and two major faces, and having an adherent, solid, second layer of a second polymer deposited on both major surfaces, the adherent solid second polymer (sic). The reference teaches an absorbing layer (embracing the instant second polymer) that fills multiple pores of the first layer".

The Examiner referred to Figure 2 and paragraphs 11-12 of the reference; this, by itself, is confusing, since the copy of Oliver et al. available to us does not have numbered paragraphs. The Examiner further referred to the second polymer layer being polyvinilidene fluoride copolymer, and column 4, lines 20-25.

What column 4 and the description of Figure 2 details is that 52 is a "layer of inert polymer material" (see sentence bridging columns 3 and 4). This layer 52 is described as being porous and is provided "to enhance integrity of the polymer electrolyte system" (column 4, lines 16-18).

With respect to any "second layer", the two paragraphs at column 4, lines 20-57 detail the selection of materials and manner of forming this second layer. This is described as being "an absorbing or gel-forming polymer 70" (column 4, lines 21 and 22). Further, the reference to curing the layer and to a "yielding a 'paste like consistency'" (column 4, line 46) that may be spread by a "doctor blade". At column 4, lines 52 and 53, it is specified that "upon cooling, the PFDF is converted to a homogenous gel". The sentence at the end of the quoted section provides that: "During the heating process as the PFDF dissolves, it seeps or is drawn into the pores of a high density polyethylene phase, thus resulting in a "filled" two-phase polymer system." From all of this, it is clear that the second layer is not a solid layer but rather is in the form of a gel or the like.

With reference to the passages extending between column 3, line 64 and column 4, line 37, of US '293, it is to be noted that these teach that the pores are completely filled with the absorbent gelling material. At some stage of the fabrication of the electrochemical cell, the absorbent gel is brought in contact with a solution of a lithium salt, as is discussed briefly in the 'Background of the Invention' of '293, in the bridging paragraph of col. 1 and 2, thereby forming a gelled electrolyte in the pores and on the faces of the separator. The excess electrolyte is removed by compression between rollers 140 and 142 (Fig. 3). However, the Examiner fails to recognize the essential difference, namely, that the process of Oliver et al. teaches the presence of only one electrolyte in their electrochemical cells, and that this gel electrolyte bearing lithium ions is a coating and completely filling the pores of an inert separator.

The Examiner correctly acknowledges that Oliver does not "expressly disclose the first multiplicity of pores unfilled, where said unfilled pores are impregnated with an organic liquid electrolyte" as required by claim 1 of the present invention. He further acknowledged that Oliver does not disclose a second multiplicity of pore sub-layers having different melting temperatures (claim 1), nor the method of preparation including: electrophoresis, vapor deposition, coating of a suspension of the suspension of the second polymer, heat-compression coating with a lithium compound containing binder compound, and immersion of the inert first porous laminate layer (claim 11).

Since Oliver et al. discloses that the second layer is in the nature of a gel or a paste, it is not seen how Oliver can in any way be construed to teach, or suggest the provision of some "unfilled" portion of pores. Rather, the teaching in Oliver is exactly to the contrary, namely that all the pores in the first polymer layer 52 should be filled.

Irrespective of the detailed teaching in Oliver et al., given the nature of the second layer, it would simply not be practical, nor would there be any reason to consider attempting, providing the second layer in a manner so as to leave some "unfilled" portion of pores.

It can further be noted that even if one accepts for the purpose of argument that somehow the Oliver et al. proposal could be carried out so as to leave some "unfilled" portion of pores, if this unfilled portion was then filled with a liquid electrolyte, there would be some interaction between this liquid electrolyte and the gel electrolyte taught by Oliver et al.

In the alternative, if the Examiner chooses to argue that it would somehow be obvious to form the second, electrolyte layer of Oliver et al. as a solid, it is submitted

that, taken on its face, this would render the Oliver et al. proposal inoperative. As noted, Oliver et al. only teach that all the pores of the first layer be filled with the second layer. If both the first and second layers are made solid, one then has a separator that does indeed separate and would prevent ions traveling between the two faces of the separator, as required for battery operation.

It is submitted that a proper prima facie obviousness argument has not been made, where there is no reason or basis to consider the modification proposed (e.g. there are no unfilled pores in the Oliver et al. proposal); or where, on a different interpretation, the reference becomes unworkable (e.g. second layer of Oliver et al. as a solid).

To go further, and somehow read into Oliver et al. that the second layer is (1) a solid and (2) is somehow provided so as to only fill part of the pores of the first layer 52 is, it is submitted amounts to reading into Oliver et al. details nowhere taught in this reference, nor any of the other references. Such a reading can only be found by hindsight analysis and by incorporating features of the present invention.

The Examiner then referred to Ashida et al. for teaching that it is well known in the art to employ multi-layer separators at different melting temperatures to prevent ignition and short circuit of batteries, and referred to column 1, lines 20-25. This passage refers to two Japanese references, JP 6,325,747 and JP 3,105,851. Applicants have obtained the Japanese references and English abstracts, which are now submitted to ensure compliance with the disclosure requirements. What these references appear to disclose is simply the provision of some homogenous separator.

While such a separator may, in some way be intended to prevent ignition in batteries, they do not provide separate sub-layers.

It is in any event submitted that there is no teaching, suggestion or motivation in this art for combining the two references in the manner taught by the Examiner.

More significantly, any such notional combination of Oliver et al. and Ashida et al. still falls short of the claimed combination in respect of the features:

- (1) As argued above, Oliver et al. does not provide a second, solid layer that includes dissociable lithium ions;
- (2) Oliver et al. does not teach filling only part of the pores and leaving the other portion of the pores unfilled;
- (3) Ashida et al. only teach separators that are generally homogenous, and they do not have separate sub-layers.

Therefore, even if one accepts the Examiner's argument that it would indeed be obvious to combine these references in the manner taught, one would have an electrolyte light having the following features:

- (1) An homogenous solid layer formed from materials having different characteristics; and
- (2) A liquid or gel-like electrolyte filling pores of the first layer.

Such a structure, as detailed above falls short in respect of the three features detailed. As such, it is submitted that a proper prima facie rejection under 35 U.S.C 103 has not been made, since this theoretical combination does not disclose all the details of the present invention. The Examiner is requested to withdraw this rejection and allow claim 1.

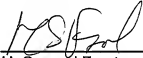
The Examiner further argued that, with respect to unfilled pores, it would have been obvious to one of ordinary skill in the art at the time of the instant invention was made to employ an electrolyte in the portion of the unfilled portions in the first layer. While Ashida et al. may indeed teach the provision of electrolyte, this again overlooks the fact that neither of the two references teach the provision of two different electrolyte layers each containing dissociable lithium ions; one layer as a solid, and the other layer as a liquid (or something other than a solid).

With respect to the method of claim 11, the Examiner argued that the features of this claim are product by process limitations. For the time being, it is submitted that this claim is indeed patentable for adding further patentable features, and for being dependent from an allowable main claim.

Early review and allowance are requested.

Respectfully submitted,

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